PROBLEMS OF QUALITY

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COST AND QUALITY OF GRINDING HOUSEHOLD AND FANCY GLASS AS A FUNCTION OF GRAIN SIZE IN GRINDING WHEELS

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Recommendations are developed for using grinding wheels with different grain sizes for finishing treatment of household and fancy glass.

The treatment of household and fancy glass in the Russian Federation in accordance with GOST 30352–96 is implemented using grinding wheels with diamond powder (GOST 9206–80). According to the standard technology, the manual finishing treatment of household and fancy glass is implemented using grinding wheels with diamond powder of grain sizes 63/50 and 50/40. In using powder with a larger grain size (80/63), the treated glass surface becomes rough, and it becomes necessary to significantly extend chemical polishing to eliminate this roughness, compared with the duration of polishing roughness caused by powders of smaller grain sizes (63/50 and 50/40) [1].

In view of amendments to GOST 9206–80 providing for screening of diamond powders taking into account the FEPA requirements, comparative testing of grinding wheels was performed using powders of grain size 75/63, 63/53, and 53/45. To determine the optimum grain size, which ensures minimal production cost and required glass quality, the effect of granularity on the cutting capacity of wheels, the specific consumption of diamonds, the unit treatment cost, and the roughness of treated surface was investigated.

The studies were performed according to the method regulated by GOST 30352–96 on a special stand made on the basis of a universal tool-grinding machine [2]. A sample was pressed to the grinding wheel with a counterweight acting via blocks installed on the machine frame, and the clamp force was monitored with a dynamometer with sensitivity 1 N. The clamping force was 40 N. The grinding depth was set at 3 mm and monitored by a depth gage with sensitivity 0.1 mm. Grinding was carried out using wheels of the shape 1E1 $100 \times 6 \times 6 \times 90° \times 32$ on M2-01 binder of hardness (85 ± 5) *HRB*. The grinding diamond powders used in the experiments had grain sizes 50/40, 53/45, 63/50, 63/53, 75/63, 80/63, and 90/75 of grade AC6 (GOST 9206 – 80). The speed of the wheel was 26 m/sec. Grinding was performed on glass bars $150 \times 100 \times 20$ mm containing 24% PbO. Water served as lubricant-coolant. The specific consumption of diamonds was determined by weighing on a VLT-1-1 scale. To determine the mean value of specific diamond consumption and the cutting capacity of a wheel, each experiment was repeated 5 times. The roughness of the treated surface was measured using a type-201 profilograph-profilometer made at the Kalibr Works.

It was found that with increasing grain size of diamond powder, the cutting capacity of a wheel and the specific consumption of diamond increase (Fig. 1) Thus, the use of

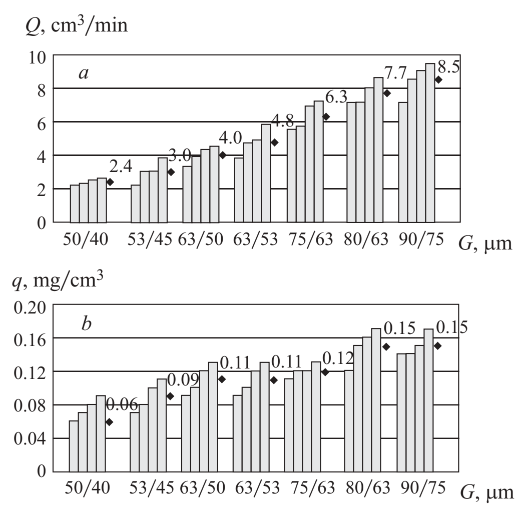

Fig. 1. Cutting capacity of a wheel Q (a) and specific consumption of diamond q (b) depending on grain size G of grinding wheels.

[1] VeAl Joint-Stock Company, Venev, Ukraine.

grinding wheels with granularity 53/45 makes it possible to increase the cutting capacity by 25%, but the specific diamond consumption increases by 50% compared to wheels with granularity 50/40. The use of wheels with granularity 63/53 makes it possible to increase their cutting capacity by 20% and virtually does not increase specific diamond consumption, compared to wheels with grain size 63/50. The use of wheels with granularity 75/63 increases their cutting capacity by 57% and increases specific diamond consumption by 9% compared to wheels with grain size 63/50.

Such criteria of grinding wheel performance as its cutting capacity and specific consumption of diamonds cannot uniquely characterize the efficiency of grinding [2, 3]. To provide economic substantiation for the selection of grinding wheel parameters, it was recommended to use the unit cost of treatment:

$$C_{\text{un}} = \frac{C_1 + C_2 + C_3 + C_4 + C_5 + C_6}{V},$$

where C_1 is the hourly wages of a machine operator, rubles; C_2, C_3, C_4, C_5, and C_6 are, respectively, the hourly cost of machinery depreciation, the cost of tools, equipment repair, electricity, and building depreciation, rubles; V is the hourly volume of ground glass, cm^3.

In determining the cost of tools it was taken that in manual treatment of household and fancy glass, 25% of the diamond layer on a grinding wheel is consumed in restoring its cutting capacity through dressing [4]. The calculation was based on prices of the Venev Diamond Tool Works (VeAl JSC).

It was found that as the grain size of diamond powder increases, the unit cost of treatment decreases (Fig. 2*a*). Thus, the use of grinding wheels with granularity 53/45 makes it possible to decrease the unit treatment cost by 17% compared to wheels with grain size 50/40. The use of grinding wheels with granularity 63/53 makes it possible to decrease the unit cost of treatment by 10%, and the use of wheels with grain size 75/63 decreases the cost by 30% compared to wheels with grain size 63/50.

The measurement of the roughness of treated surface established that with increasing grain size, the roughness increases (Fig. 2*b*). Thus, using wheels with grain size 53/45 increases the roughness of treated surface by 100% compared to a wheel with grain size 50/40.

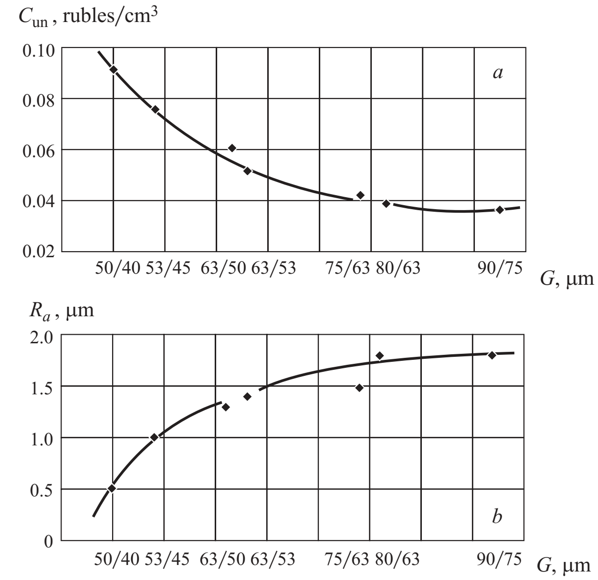

Fig. 2. Unit cost C_{un} of grinding (*a*) and roughness of treated surface R_a (*b*) depending on the grain size G of wheels.

The use of wheels with grain size 63/53 virtually does not increase the roughness of the surface, and using wheels with grain size 75/63 increases the roughness of treated surface by 25% compared to wheels with grain size 63/50.

Thus, the use of grinding wheels with grain size 63/53 and 75/63 makes it possible to lower the unit cost of finishing treatment of household sand fancy glass by 10 and 30%, respectively. In the first case the roughness of the treated surface virtually does not increase, and in the second case it increases by 30%.

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